Efficiency Standards Working Group

GREENHOUSE MITIGATION MEASURES - EFFICIENCY STANDARDS FOR POWER GENERATION

ISSUES PAPER

May 1998

BACKGROUND

The Prime Minister's November 1997 Statement, *Safeguarding the Future: Australia's Response to Climate Change,* provides details of actions which demonstrate the Commonwealth Government's commitment to an effective national greenhouse response. The $180 million package will significantly reduce Australia's greenhouse gas emissions below projected levels. The full text of the Prime Minister's Statement can be found on the World Wide Web at http://www.erin.gov.au/portfolio/esd/climate/pmstate.html.

In recognition of the contribution of energy to Australia's growth in greenhouse gas emissions, the package contains a range of measures which address both the supply and demand side of energy use. On the supply side, actions to encourage the development of cost effective renewable energy, and standards to improve the efficiency of fossil fuel conversion, are key measures.

This paper focuses on implementation issues associated with the *Efficiency Standards for Power Generation* measure.

The Efficiency Standards Working Group

An Efficiency Standards Working Group has been established to develop proposals for implementing by the year 2000 efficiency standards for fossil fuel electricity generation, so as to deliver reductions in the greenhouse gas intensity of energy supply. The Efficiency Standards Working Group is represented by States, Territories and industry and is chaired by the Australian Greenhouse Office (AGO). The AGO was established to coordinate domestic greenhouse policies and programs at the Commonwealth level.

The Working Group is due to complete its work by December 1998. The Working Group reports to the Greenhouse Energy Group, which is responsible for overseeing work relating to other greenhouse and energy initiatives, and which reports on a regular basis to the Council of Australian Governments (CoAG) High Level Greenhouse Group. It is this High Level Group which will provide advice to government on implementation of efficiency standards, based on advice from its subsidiary bodies.

Process and timeframes

Given lead-in times, an earliest possible announcement is desirable to allow investor certainty.

Ideally, the standards should be agreed in time for announcement towards the end of 1998. If required, legislation could then be developed by September 1999.

Public Consultation - Role of the Issues Paper

The Working Group will be seeking the views of stakeholders in developing implementation proposals. This issues paper raises key issues which will need to be addressed. It does not represent the final views of any member of the Working Group. The public is asked to make written submissions indicating their views on these and related issues.

Two half-day consultation forums on the same day will be held in Brisbane, Sydney, Melbourne, Adelaide and Perth in late May. The morning session will cover the efficiency standards measure and the afternoon session will cover another of the key measures in the Prime Minister's Statement focussed on electricity generation from renewable energy sources (see Issues Paper at http://www.environment.gov.au/net/consulten.html) The objective of the public consultation forums is to explain the objectives of the measure, clarify any uncertainties remaining from this issues paper, canvass major issues and ensure stakeholders are aware of how they may participate in the process.

It is expected that detailed views on issues will be presented in submissions and informal consultations. Following consideration of submissions and further development work, there will be further opportunity for public input.

THE ISSUES PAPER

This Issues Paper is intended to assist individuals and organisations prepare written submissions on the efficiency standards for power generation measure described in the Prime Minister's Statement on Climate Change of November 1997. The AGO will be accepting submissions on behalf of the Efficiency Standards Working Group.

The aim of the paper is to raise issues and questions relating to implementation of the Prime Minister's initiative of increasing the efficiency of power generation in Australia.

KEY DATES

Discussion Paper publicly available	16 May 1998
Public Consultation Forums	
Brisbane	25 May 1998
Sydney	26 May 1998
Melbourne	27 May 1998
Perth	28 May 1998
Adelaide	29 May 1998
Due date for submissions	26 June 1998

You can register your intention to attend the Public Consultation Forums at the Internet site below, or by contacting Angela Nicol (ph: 02 6274 1034; fax: 02 6274 1439).

FURTHER INFORMATION

For further information please contact:

Mr Stephen Bygrave
Phone: (02) 6274 1199
Fax: (02) 6274 1439
email: stephen.bygrave@ea.gov.au

Postal address for submissions:
Australian Greenhouse Office
GPO Box 787
CANBERRA ACT 2600

Internet site for more information, and registration for public consultation forums: http://www.environment.gov.au/net/consulten.html

HOW TO MAKE A SUBMISSION

Anybody can make a submission. It can be as short as a letter outlining your views on a few aspects or a more detailed document covering a wide range of details. Where possible, submissions should contain relevant data and documentation to support the views expressed.

Commercially sensitive information that you do not wish to be made publicly available should be provided under a separate cover and clearly marked COMMERCIAL IN CONFIDENCE.

In addition to a hardcopy of your submission, it would be helpful if you could provide the Australian Greenhouse Office with an electronic copy of your submission on diskette or by email to stephen.bygrave@ea.gov.au

ISSUES

Origin of the Measure

As part of a broader package of national greenhouse response measures, the Prime Minister's Statement ***Safeguarding the Future: Australia's Response to Climate Change,*** specifies:

> The Commonwealth will work with the States to achieve movement towards best practice in the efficiency of electricity generation conversion by implementing efficiency standards for different fossil fuel classes, so as to deliver reductions in the greenhouse gas intensity of energy supply. Standards will apply to new electricity generation, significant refurbishments and existing generation.

As part of a commitment to effective national greenhouse response, the measure promotes progress towards best practice in the efficiency of energy supply, while recognising national circumstances in fuel choice. The measure needs to be achieved while maintaining the competitiveness of the Australian economy. Issues such as cost effectiveness and maximising certainty for investments need to be taken into account. Specific objectives of the efficiency standards are:

- to achieve movement towards best practice in the efficiency of fossil-fuelled electricity generation; and
- to deliver reductions in the greenhouse gas intensity of energy supply.

Scope - Fuel classes

Basing the standard on the efficiency of the fossil fuel combustion process implies the need to establish one or more standards relating to each of the major fossil fuel combustion classes (ie brown coal, black coal, natural gas and oil) and sub classes.

Efficiency within a class can also be affected by the application (eg. baseload natural gas versus peaking natural gas) and a range of other factors. There is potential for a large proliferation in the number of classes dependent on the number of dissimilar applications.

The intention behind the measure is to develop standards that do not discriminate against particular fuel classes or between new and existing plants. Equity between fuel classes, and between existing and new plant, is a key performance criterion for this measure.

Standards should also be able to be periodically upgraded over time to reflect changes in technology and other factors.

Relation to greenhouse response policy

It is recognised that there are a number of options available to reduce Australia's greenhouse gas emissions, and that efficiency standards for power generation are only one element in a national response. The measure needs to be developed with an eye to possible future greenhouse policy developments, including potential emissions trading schemes. However, this issues paper does not address these broader issues.

The following sections outline issues relating to the power generation energy efficiency measure. It is not intended to be an exhaustive list. Issues relate to parameters of the standard, how it could be applied, to whom, and how it could be implemented and monitored.

At the end of each section are questions that will need to be assessed in designing the measure. The questions frame issues to be raised in the consultation process. Questions listed are not exhaustive and there may be others that will need to be addressed.

1 What constitutes best practice?

The objective of the measure is to achieve movement toward best practice in the efficiency of electricity generation. This requires some assessment of what is best practice. The aim is to move beyond business-as-usual measures, so that the greenhouse benefits are over and above what would be achieved through maintaining current practices. The intention would be to implement commercially available technologies, technical improvements or modifications within the constraints of the commercial and physical environment of the Australian power sector. Implementation of the standard needs to consider the reality of commercial decisions, and not cause inequities.

What is commercial best practice in the Australian context?

What action is required by electricity generators to achieve commercial best practice?

What does achieving commercial best practice mean for an existing power station?

What are the implications of adopting commercial best practice for competition in the national electricity market?

In meeting best practice in electricity generation, it will be important to consider the form of efficiency standards, the coverage of efficiency standards, and implementation of standards.

2 Form of Standards

There are a number of forms that the standard could take. Threshold issues include:

- whether the standard is based on greenhouse gas emissions or thermal efficiency;
- whether there should be a single standard per fuel class, sub class or a range of fuel class standards;
- how standards for existing plants and new plants relate;
- whether the standards should be applied to the maximum continuous rating of the plant or over the full range of operating loads; and,
- whether the standard should be based on design and/or operating requirements.

Key criteria, which should be met by the efficiency standard measure, include:

- conversion efficiency best practice in reducing greenhouse gas emissions;
- economic, technical and regulatory efficiency;
- equity between new and existing plant, between fuel classes, and social equity;
- flexibility;
- incentives for continual improvement;
- cost effectiveness, including cost of monitoring and compliance; and
- simplicity, permitting ready comparison of power plant burning the same fuel.

There are a number of variables which will generally determine the technical efficiency of electricity generation. Variables include:

- fuel type (brown coal, black coal, gas, oil) and quality;
- the size or capacity of the plant;
- the type and age of technology;
- the level of loading and capacity factor for the plant;
- plant modifications;
- the cooling water system process;
- the requirements of local environmental regulations; and,
- ambient conditions such as temperature, pressure and humidity.

Because of these variables, it may be difficult to apply one standard across all power plants of a given fuel class. Defining a standard which takes every variable into consideration could lead to standards being plant-specific.

Emission or thermal efficiency

The intent of the measure is to focus on the efficiency of power generation conversion.

Possible ways of measuring power generation efficiency include:

- thermal efficiency, expressed as a percentage of the energy content of fuels converted to useful electricity or heat; or,
- quantity of greenhouse gases generated per unit of useful energy delivered (eg kg of CO_2 per MWh);

for each fuel class or sub class.

The advantage of a thermal efficiency standard is that it is generally already monitored by power stations, although the basis and accuracy of the measurements may vary between plant. A disadvantage is that it is not a measure of the greenhouse intensity of the electricity dispatched.

The advantage of an emission standard is that it measures efficiency in a way that is meaningful to the intent of the measure: reducing the greenhouse intensity of electricity generation. Measurement of emissions need not be more complex than for thermal efficiency as it can be based on simple mass-balance approaches, and is already determined by many power stations as part of their Greenhouse Challenge agreements.

What is the best way to measure the energy efficiency of electricity generation?

What is the best form of the standard to meet the objectives of the measure?

If there are different standards by fuel classes, are there any significant differences between greenhouse emission standards and thermal efficiency standards?

How could this measure be implemented to preserve Australia's comparative advantages?

A single standard or many standards?

As discussed above, the efficiency of electricity generation will depend on a range of variables, making it difficult to apply a single standard to every power plant in Australia, even within a fuel class. However, there may be a number of possible approaches to developing standards which account for differences, including:

a. defining a numerical efficiency standard on the basis of a percentage improvement over time;
b. requiring a level of efficiency based on using an equivalent technology that is commercially available; or

c. designing an algorithm which incorporates relevant variables to arrive at a specific standard for a particular circumstance.

Is it possible to have a single efficiency standard that can be applied to all power plants within a fuel class?

What is the best balance between manageability and effectiveness?

Design vs Operational Standards

Another issue is whether the performance indicator should be met as a *design* requirement at installation, or as an average *operational* requirement over a particular period (eg annually).

In the case of a design requirement, the technology could, for new plants or major refurbishments, be accredited prior to construction, and perhaps monitored periodically after operation commenced, to ensure that it could deliver the accredited rating.

- The issue of whether (how often and under what conditions) the conversion efficiency deviates from the design rating will have bearing on the effectiveness of this approach.
- A key issue associated with developing a design standard is avoiding a "business-as-usual" outcome for existing plant.

On the other hand, an operational requirement would, for all plants, ensure that there is an incentive to operate, and where necessary modify, the equipment at best practice for the whole of the life of the plant. However, an operational requirement may have greater reporting and monitoring costs, as the amount of fuel use and the amount of useful energy converted, during the specified period, would need to be measured, reported and monitored.

- Options for monitoring and reporting an operational requirement would need to be developed.

How could a design standard be applied to existing plant while achieving movement towards best practice?

Because plants can be continually modified, is it preferable to have an operational, performance based standard? If so, how could one be devised?

Should both standards be applied?

Can separate design and operational standards be prepared?

3 Coverage

Existing vs new plant

It is intended to set standards for new and existing power generation plants. If the standard is applied only to new plants, then there may not be enough incentive for existing plants to increase efficiency. On the other hand, depending on the form of the standard, it may not be possible to apply the same standard to new plants and existing plants. There are limits on the commercial viability of retrofitting new technology to existing plant. However, efficiency of existing plant can often be improved with benefits exceeding costs. If existing plants are treated less stringently, then new plants and new investments could be disadvantaged.

Traditionally it has been assumed that power plants have a finite life. However, life optimisation programs and refurbishments using improved materials can be used to significantly improve the availability and efficiency of plant, and extend the life of boilers and turbines. Based on current understanding of equipment ageing, plant may be able to operate for 60 or more years. This will influence how standards are applied to existing plants.

What is the life expectancy of existing plants?

Should repowering be covered under new or existing plant standards, or treated separately?

Standards for new plant will be able to be strengthened at an earlier stage provided sufficient lead-in time is given. However, depending on the nature of the standard, changes to standards for existing generation may require longer phase-in and compliance periods. Consideration should be given to the degree to which standards for existing generation could converge with the new generation standards through time.

In addressing these issues, it will be necessary to consider the life cycle of plant, write-off of investment, costs of moving to new technologies, etc.

How can the standards be applied to both existing and new plants?

Should new and existing standards converge over time? If so, how could this be done?

How will the standards for existing (and refurbished) plant be implemented to ensure no bias or incentive to defer re-investment?

How can a timetable for introduction of standards be devised such that market distortions can be avoided?

Emerging technologies

There are a number of emerging technologies that will need to be covered by the energy efficiency measure. Co-firing is an example of a different category of power plant which utilises gas to enhance coal combustion while reducing nitrogen oxide and greenhouse gas emissions. The energy efficiency standard will need to be updated over time to account for emerging technologies and changes in technology. Examples of emerging coal technologies include:

. Pressurised Fluid Bed Combustion (PFBC);
. Integrated Gasification Combined Cycle (IGCC); and,
. Advanced Pressurised Fluid Bed Combustion (APFBC).

Fuel cell technology is an example of an emerging gas technology.

The standards should be proactive in driving technical innovation and uptake, recognising that major technological innovations generally occur outside Australia. Clearly projecting improvement in the standards into the future will be an important component, particularly for new generation.

How can standards be updated over time to account for changes in commercially available technologies appropriate for Australia's circumstances?

What lead times are needed for industry to adjust to new standards for new and existing plant?

Could these standards drive technical innovation?

Cogeneration

The standards should encourage cogeneration, as cogeneration achieves high thermal efficiencies relative to other technologies, where the heat is used efficiently. However, this requires location of appropriate heat loads at the generation point and a specification of heat load efficiency and electrical load efficiency.

How should the standards provide appropriate and realistic incentives for the efficient use of cogeneration?

If cogeneration is included in the standard, how should process heat be measured and accounted for?

What current market signals are barriers to cogeneration?

Which gases?

If standards are implemented through measuring emissions, a definition of relevant greenhouse gases is needed. The National Greenhouse Gas

Inventory shows that, in 1995, more than 99% of emissions (in terms of global warming potential) from electricity and heat production was in the form of carbon dioxide (CO_2).

Would it be sufficient for a standard based on greenhouse emissions to focus on CO_2 only?

What fuels?

Sources of electricity which do not involve fossil fuels will be exempt from the standards. This implies the need for close definition of 'fossil fuels' and activities to which the standards are applicable.

Other than the traditional use of coal, gas and oil, which fuels should be covered by the standard?

Size / Scale

The underlying objective of the standards is to lift the efficiency of new (and existing) electricity generation capacity in each fossil fuel class. There may be a large number of small generators (<1 MW) in Australia operating at very low efficiencies that could be targeted by the measure. However, for reasons of cost and administrative effectiveness there could be a minimum size cut-off in the size of unit to which the standards will apply. However, this raises a number of complexities which will need to be addressed.

Plants of less than 30 MW at a common grid connection point are not required to bid into the National Electricity Market (NEM). Plants with an operating size smaller than 30 MW possibly represent less than 5% of total plant.

A definition of plant and a consideration of total plant capacity is important here. Given that technology in each fuel class is in discrete sizes of differing performance the issue of whether the standards will be on the basis of and cover individual equipment or total power station capacity will need to be considered. For example, mining operations with stand-alone generation may use a number of small generators which in total exceed a 30 MW cutoff (eg. 4 generators of 10 MW capacity), while a grid connected generator may install a single Frame 6 (36 MW) gas turbine.

If there is a size limit, is it possible to limit perverse incentives at the margin to use many small sub-optimal generators?

What is an appropriate cut-off point for large and small generators?

How should multiple units be counted?

Where is output measured?

The aim of the measure is to focus on the efficiency of electricity generation activities; it is not intended that transmission or distribution losses would be included in the measure. However, consideration will need to be given to whether electricity is measured as generated or sent out. Internal consumption of electricity at power station sites can range from 1% to 20%.

Is generated or sent out electricity a more appropriate measure?

Should the measure include energy used within a power station? If so, where is the boundary?

Permissible offsets

An offset is an action which operators can take to reduce greenhouse gases, and would include actions such as tree planting and other sink creation. While such action may indeed reduce greenhouse gas emissions, the primary objective of the measure is to promote best practice in power generation with respect to thermal efficiency and reduction of greenhouse gases from generation activities. It should also be noted that other measures in the National Greenhouse Response deal with sinks. In addition, while sinks can assist in reducing greenhouse gases in the medium term, it is necessary to address energy emissions directly to meet long term greenhouse gas reduction targets.

While offsets would generally not be included as part of this measure to increase energy efficiency, there may be some cases where offsets may have a role, such as with a plant nearing the end of its life. Action to increase the energy efficiency of such a plant may not be practical.

Is it possible to include offsets in a way that is consistent with the objective of the measure?

Are there benefits in considering offsets for a plant that is approaching the end of its life?

4 Implementation of standards

There is a need to ensure that standards are implemented in an efficient, transparent, non-duplicative and consistent way. In implementing standards, it will be essential to avoid a proliferation of compliance points for industry.

It will be necessary to examine legislative and non-legislative options for implementing the measure, recognising the need for certainty and consistency in application. If legislation is proved to be an effective implementation option, national legislation may provide a uniform

means of implementing the measure. It may be simpler and more efficient if individual States and Territories amend existing legislation to promulgate the requirement.

A key issue will be the legislative options in the various jurisdictions, and mechanisms to achieve consistent and timely legislative power. A further issue will be whether environmental or electricity legislation provides the best legislative base for implementing the measure, as well as any impediments and difficulties in amending existing legislation. If State / Territory legislation is to be utilised in implementing the standard, it will be necessary to ensure that legislation is complementary and that there is national consistency.

There may be other means to achieve the objectives of the measure. The National Electricity Code sets out market rules for a considerable portion of national electricity use, although the Code includes no environmental objectives.

Are there non-legislative means to deliver the objectives of the measure with necessary certainty and consistency?

Is State / Territory legislation suitable for implementing energy efficiency standards for electricity generation? Will this achieve necessary consistency?

Given the lack of environmental objectives in the National Electricity Code, is it appropriate and could it be effective to implement the measure through the Code? How could consistency of treatment of jurisdictions outside the National Electricity Market be achieved?

Financial Impacts on Generators and Consumers

Insofar as the measure changes investment and operating decisions of generators, it will have impacts on costs and profitability. These could affect not just generators, but their intermediate and final customers. For some industries, electricity is a major element of costs. Many energy intensive industries operate in competitive international markets. The measure is to be achieved while maintaining international competitiveness.

What are the financial impacts of standards likely to be?

What portion of costs will be borne by generators or passed on to customers?

What will be the likely impacts on customers, including energy-intensive industries?

What is the potential for perverse market / regional outcomes?

Monitoring and compliance

Monitoring and compliance cost is a key parameter in determining the final form of implementation. Cost effectiveness suggests that existing mechanisms for monitoring and compliance should be used wherever possible. Judgements here will have strong bearing on the choice of the best implementation mechanism.

If standards were based on the design specification, there would be a need to accredit all new and existing installations.

- Accreditation of new installations could be accomplished at the same time as other compliance procedures under legislation (through an environmental impact assessment process for example). However, accreditation of existing installations would be a large and distinct task.

If the standard is to be based on an operational requirement, reporting and monitoring systems would need to be established. Monitoring should be based on best practice, for example - microprocessor based diagnostic systems monitoring plant performance. This improves efficiency and plant life, while reducing operating and maintenance costs.

The following would need to be measured and reported :

- Fuel consumed and its energy content;
- Useful energy produced or dispatched, as electricity and heat;
- Energy consumed within the plant;
- Carbon emissions calculated by mass balance (if emission standard used).

The underlying conversion efficiency or emission rate could then be calculated.

Penalties for non-compliance need to be assessed. The choice of legislative instrument may influence the non-compliance mechanism.

What are the monitoring and compliance costs of different approaches?

What protocols exist for measuring conversion efficiency or emission rates?

How suitable are these protocols for the purpose of determining compliance with this measure?

What reporting mechanisms already exist and how suitable are these for monitoring compliance with the measure?

What penalties for non-compliance are appropriate?

Mechanisms

Another issue that will need to be addressed is the mechanism to implement efficiency standards. Mechanisms will be required to:

- gather data on current performance in terms of efficiency;
- assess the level of efficiency that enterprises should be;
- assess how enterprises can achieve that level of efficiency; and,
- assess how enterprises can stay at that level of efficiency.

What is the appropriate assessment / compliance mechanism?

What mechanisms are available to advise on means of achieving and maintaining levels of efficiency?